Risk Factors in Development of Postoperative Empyema

Postoperatif Ampiyem Gelişiminde Risk Faktörleri

Postoperatif Ampiyem / Postoperative Empyema

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Özet

Amaç: Postoperatif ampiyem oluşumunda birçok etiyolojik faktör rol oynamakta olup çalışmamızda bu faktörlerin ampiyem gelişimindeki etkilerini tespit etmeyi amaçladık. Gereç ve Yöntem: Kliniğimizde Ağustos 2009 - Mayıs 2010 tarihleri arasında, primer ampiyem dışında herhangi bir nedenle tüp torakostomi uygulanan ve/veya opere edilen 288 olgu ampiyem gelişimi açısından prospektif olarak incelendi. Olgular, cinsiyet, yaş, kemoradyoterapi, cerrahi prosedür, intraoperatif povidon iyotla toraks lavajı, acil operasyon durumu, başka ampiyem olgusu ile aynı odayı paylaşma, primer hastalık, eşlik eden ek hastalık, operasyon süresi, dren sayısı, komplikasyon, odadaki kişi sayısı, dren alınma ve yatış süreleri açısından takip edildi. Çalışmaya alınan tüm olgulardan 3 gün arayla kanda lökosit-nötrofil sayımı yapıldı ve drenli olgulardan eş zamanlı dren sıvısı kültürü için örnek alındı. Dren sıvısı kültür örnekleri "Otomatize bakteri identifikasyon ve antibiyotik duyarlılık testi" ile standart şekilde değerlendirildi. Ampiyem kliniği gelişen ve/veya dren kültür örneklerinde bakteriyel üreme gerçekleşen olgular risk faktörleri açısından incelendi. Elde edilen bulgular SPSS 16 veri analiz programı ile değerlendirildi. Bulgular: Cinsiyet, yaş, kemoradyoterapi, cerrahi prosedür, intraoperatif povidon iyotla toraks lavajı, acil operasyon durumu, başka ampiyemli ile aynı odayı paylaşma gibi risk faktörlerinin postoperatif ampiyem gelişim riski ile ilişkisi istatistiksel olarak anlamlı saptanmadı. Primer hastalık ($p<0.05$), eşlik eden ek hastalık ($p<0.05$), operasyon süresi ($p<0.05$), dren sayısı ($p<0.05$), komplikasyon ($p<0.01$), odadaki kişi sayısı ($p<0.05$), dren alınma süreleri ($p<0.05$) ve yatış süresinin ($p<0.05$) postoperatif ampiyem gelişimine katkısı anlamlı olarak tespit edildi. Tartışma: Göğüs cerrahisinde, tüp torakostomi uygulanan ve postoperatif hastalarda karşılaşılan en ciddi sorunlardan biri ampiyem gelişimidir. Bu nedenle cerrahi öncesi dönemde mevcut riskler iyi değerlendirilmeli ve bu riskleri en aza indirecek yaklaşımlar sağlanmalıdır.

Anahtar Kelimeler

Ampiyem; Risk Faktörleri; Postoperatif

Abstract

Aim: Many etiological factors play a role in the occurrence of postoperative empyema. We aimed to define the effects of these factors on the development of empyema. Material and Method: Two hundred and eighty-eight cases from our clinic who underwent tube thoracostomy and/or were operated due to any cause out of the primary empyema between August 2009 and May 2010 were prospectively studied in terms of empyema development. Data comprised gender, age, chemoradiotherapy, surgical procedure, intraoperative thoracic lavage with povidone-iodine, emergency surgery status, sharing the same room with other cases with empyema, primary disease, additional comorbidity, operation duration, drain number, complication, number of patients in the room, and drain discontinuation and hospitalization duration. Blood leukocyte-neutrophil count was ordered in all cases at 3-day intervals, and fluid culture specimens were simultaneously collected from cases with drains. Drainage fluid culture specimens were evaluated with "Automated Identification and Antibiotic Susceptibility Testing" using standard procedures. Empyema cases who developed clinical manifestation and/or with bacterial growth in culture specimens were studied in terms of risk factors. The findings were analyzed using SPSS (version 16). Results: The results showed that gender, age, chemoradiotherapy, surgical procedure, intraoperative thoracic lavage with povidone-iodine, emergency surgery status, and sharing a same room with other empyema cases were not significantly correlated with the risk of empyema development. Contribution of the primary disease ($p<0.05$), additional comorbidity ($p<0.05$), operation duration ($p<0.05$), drain number ($p<0.05$), complication ($p<0.05$), number of people in the room ($p<0.05$), drain discontinuation time ($p<0.05$) and hospitalization duration ($p<0.05$) were found to be significant in the development of postoperative empyema. Discussion: Postoperative development of empyema is one of the most serious problems encountered in patients who have undergone tube thoracostomy. Therefore, current risks should be thoroughly assessed in the preoperative period and approaches to minimize these risks should be adopted.

Keywords

Empyema; Risk Factors; Postoperative

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Introduction

Postoperative empyema is a condition in which all the pleural structures are infected, and has an incidence of between 2% and 6% [1,2]. Empyema may emerge in the early or postoperative periods, depending on different etiological agents. Postoperative development of empyema is one of the most serious problems encountered in thoracic surgery related to the failure of discontinuation of tube drainage in the early period. Empyema constitutes a serious problem out of the primary disease, prolonging the duration of hospital stay and causing morbidity and/or mortality. Therefore, current risks should be thoroughly assessed in the preoperative period; approaches to minimize these risks should be adopted and effective treatment methods should be chosen in the postoperative period, with good supporting therapy [3]. In this study, we aimed to define the effects of risk factors for postoperative empyema.

Material and Method

This study was approved by the local ethics committee in accordance with the 2008 Helsinki Declaration. All of the patients included in the study were informed, and their consents were received. Two hundred and eighty-eight cases who had undergone tube thoracostomy and/or were operated due to any cause out of the primary empyema in our clinic between August 2009 and May 2010 were prospectively studied in terms of empyema development. The cases admitted due to primary empyema were excluded from the study. The patients were assessed in terms of the gender, age, chemoradiotherapy, surgical procedure, intraoperative thoracic lavage with povidone-iodine, emergency surgery status, sharing the same room with other cases with empyema, primary disease, additional comorbidity, operation duration, drain number, complication, number of people in the room, and drain discontinuation and hospitalization times. Blood leukocyte-neutrophil count was ordered in all the cases at 3-day intervals, and specimens were simultaneously collected from the cases with drains for analysis of drainage fluid culture. Drainage fluid culture specimens were evaluated with "Automated Identification and Antibiotic Susceptibility Testing" using standard procedures. All changes in potential risk factors were recorded. The cases were not directed about the determined risk factors. Cases who developed clinical manifestation of empyema (purulent drainage) or who showed bacterial growth in culture specimen were statistically analyzed. Control group composed of patients without empyema.

Statistical Analysis

Data were analyzed in SPSS (version 16), using chi-square, logistic regression, independent samples T test and Mann–Whitney U tests. Values of $P<0.05$ were considered statistically significant.

Results

Ten of 288 cases included in the study developed postoperative empyema, which was diagnosed both clinically and microbiologically.

Gender:

Of the patients, 217 (75.3%) were males and 71 (24.7%) were females. Postoperative empyema occurred in 9 (4.1%) of the male cases and 1 (1.4%) of the female cases (Table 1). When the correlation of the gender with postoperative empyema was statistically examined, although 90% of the cases with empyema were males, the contribution of gender to postoperative empyema was not found to be statistically significant ($p>0,05$).

Age:

Mean age of the cases was 45.9 (10–81 years). The patients who developed empyema were predominantly aged 41 to 60 years old (20% were aged 41–50; 60% aged 51–60). Development of empyema was observed in 2 (4.1%) of 49 patients aged 41–50, 6 (7.2%) of 83 cases in the 51–60, 1 (6.2%) of 39 cases aged 21–30 and 1 (6.2%) of 16 cases aged 71–80 years old (Table 1). Statistical analysis showed that age was not a significant contributory factor in development of postoperative empyema ($p>0,05$).

Chemoradiotherapy (CT/RT):

Of the cases included in the study, 19 (6.6%) had a CT/RT history within the previous year due to various malignancies. None of the patients with CT/RT history developed empyema during the postoperative stay in the hospital (Table 1) ($p>0,05$).

Primary Disease:

Of the patients, 99 (34.3%) were operated due to malignancy, 68 (23.6%) for parenchymal disease, 57 (19.7%) for infectious diseases, and 64 (22.2%) due to other reasons (Table 1). Diagnoses of the cases included in the study are shown in Table 2. When the 10 cases of the empyema group were examined for primary diseases, 8 cases were in class of malignancy, 1 case in parenchymal disease, and 1 case in infectious disease class. The 8 malignancy cases that developed empyema constituted 80% of the empyema group ($p<0.05$), while 8% of the cases operated due to malignancy subsequently developed empyema. .

Additional Comorbidity:

Of our patients, 186 cases had no comorbidity accompanying the primary disease, 24 (8.3%) had diabetes mellitus (DM), 27 (9.4%) hypertension (HT), 11 (3.8%) goiter and 41 (14.2%) chronic obstructive pulmonary disease (COPD) (Table 1). The empyema group included 3 (12.5%) cases with a history of DM, 3 (7.3%) cases with COPD and one case (3.7%) with HT. When the risk of empyema development was examined in terms of comorbidity, 3 cases in the empyema group had no comorbidity, 3 had DM, 3 had COPD, and 1 patient had HT. Logistic regression showed that the incidence of DM was significantly higher in cases of empyema development (8.6 times) ($p<0,05$).

Surgical Procedure:

Of the patients, 113 (39.2%) underwent lobectomy, 14 (4.8%) ligation of bullae, 29 (10%) cystotomy, 13 (4.5%) decortication, and 20 (6.9%) Video-assisted thoracoscopic surgery (VATS), 24 (8.3%) pneumonectomy, 70 (24.3%) tube thoracostomy, and 5 (1.7%) cases underwent other surgical procedures (Table 1). When the empyema cases were examined, 8 cases (80%) underwent lobectomy, 1 (10%) pneumonectomy and 1 (10%) patient underwent (10%) ligation of bullae; no empyema development

Table 1. Analysis of Risk Factors

	%	CONTROL	EMPYEMA	P
GENDER				0.274
Male	75.3	208	9	
Female	24.7	70	1	
AGE GROUPS				0.173
0-20	9.7	28	0	
21-30	13.5	38	1	
31-40	12.5	36	0	
41-50	17	47	2	
51-60	28.8	77	6	
61-70	12.5	36	0	
71-80	5.5	15	1	
80 and over	0.3	1	0	
CHEMORADIOTHERAPY				0.392
Absent	93.4	259	10	
Exist	6.6	19	0	
ADDITIONAL COMORBIDITY				0.011
Absent	64.2	182	3	
DM	8.3	21	3	
HT	9.4	26	1	
GOITER	3.8	11	0	
COPD	14.2	38	3	
PRIMARY DISEASE				0.013
Malignancy	34.3	91	8	
Parenchymal Disease	23.6	67	1	
Infectious	19.7	56	1	
Other	22.2	64	0	
SURGICAL PROCEDURE				0.060
Lobectomy	39.2	105	8	
Bullae ligation	4.8	13	1	
Cystotomy	10	29	0	
Decortation	4.5	13	0	
VATS	6.9	20	0	
Tube thoracostomy	24.3	70	0	
Other surgical procedures	1.7	5	0	
Pneumonectomy	8.3	23	1	
DRAIN NUMBER				0.018
1 drain	46.6	133	1	
2 drains	53.4	145	9	
THORACIC LAVAGE WITH				
POVIDONE-IODINE	0.731			
Not performed	74.7	208	7	
Performed	25.3	70	3	
COMPLICATION				0
Absent	89.6	258	0	
Prolonged air leakage	8.3	15	9	
Chylothorax	0.3	1	0	
Revision operation	1.4	3	1	
Atelectasis	0.3	1	0	
NUMBER OF PEOPLE IN THE ROOM				0.030
Single rooms	11.1	28	4	
Double rooms	9.7	27	1	
Triple rooms	67	189	4	
Quad rooms	12.2	34	1	
EMERGENCY SURGICAL INTERVENTION				0.071
Elective	76	209	10	
Emergency	24	69	0	

Table 2. Details of the cases diagnosed

	N	%
Squamous cell carcinoma	39	13,5
Adenocarcinoma	19	6,6
Adenosquamous carcinoma	5	1,7
Small cell carcinoma	1	0,3
Large cell carcinoma	1	0,3
İnterstitial lung disease	4	1,4
Pneumothorax	50	17,4
Pneumonia	7	2,4
Bronchiectasis	16	5,6
Metastatic lung cancer	12	4,2
Diaphragm hernia	1	0,3
Chest wall resection	1	0,3
Hydatid cyst	29	10,1
Mesothelioma	6	2,1
Pleural effusion	21	7,3
Other diseases	18	6,2
Chronic pleuritis	23	8
Rare tumors of the lung	16	5,6
Bullous lung	14	4,9
Pulmonary aspergilloma	5	1,7
Total	288	100

was observed in patients who underwent cystotomy – decortication – VATS - tube thoracostomy and other surgical procedures during the stay in the hospital. When effects of the operations on the empyema development were examined, 8 (7.1%) of the cases who underwent lobectomy, 1 (7.1%) case of ligation of bullae and 1 of case (4.2%) developed empyema. No significance was found between the surgical procedure and risk for empyema development (p>0,05).

Operation duration:

Considering all the cases, mean operation duration was defined as 151 minutes, compared with 257 minutes in the empyema group and 147 minutes in the controls. On examination, development of empyema was not observed in operations that lasted less than 210 minutes, while more empyema development was found in those of duration longer than 230 minutes (Chart 1). The risk of developing postoperative empyema was significantly higher cases with longer operation durations (Table 3) (p<0.05).

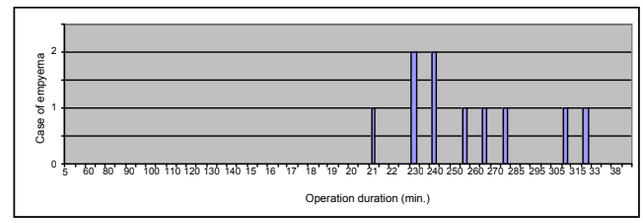

Chart 1. Evaluation of the correlation between the operation duration and empyema development

Drainage discontinuation time:

Considering all the cases, mean discontinuation of postoperative basal drainage was 2.8 (1–15) days, while mean discontinuation of apex drainage was 4.8 (1–41) days (Table 3). In

Table 3. Statistical analysis of the operation duration, basal-apex drainage discontinuation time and hospitalization time.

	N	Mean	Std. deviation	Min.	Max.	U	P
Operation duration	288	151,58 (min.)	103,545	5	470	473,500	0
Basal drainage discontinuation time	153	2,84 (day)	1,796	1	15	105,500	0
Apex drainage discontinuation time	287	4,85 (day)	4,204	1	41	334,500	0
Hospitalization time	288	7,57 (day)	4,881	2	42	68,500	0

the empyema group, mean discontinuation time was 6.1 (3–15) days for basal drainage and 16.3 (1–41) days for apex drainage. Basal drainage was discontinued at the second day in 52.3%, at the third day in 20.9%, and at the fourth day in 11.8% of the cases. The highest risk for development of empyema (37.5%) was in the cases with basal drainage discontinued at the fourth day. On statistical analysis of the basal drainage discontinuation time, risk for the postoperative empyema was found to increase with prolongation of the discontinuation time (p=0). In terms of apex drainage, 27.2% of cases were discontinued on the fourth day and 18.5% on the third day. Empyema was observed to develop in cases with failure of apex drainage, where discontinuation occurred after a period of 9 days and more. The correlation between the apex drainage discontinuation time and empyema development was statistically significant (p<0.05).

Hospitalization time:

Mean hospitalization duration was 7.5 (2–42) days (Table 3). The majority of cases (51 cases, 17.7%) were hospitalized for 7 days. The risk for empyema development was found to increase in cases hospitalized for 12 days or more. Postoperative empyema was detected in 10 (3.5%) cases, while the mean time of empyema development in the cases with empyema was 6.6 (3–12) days. Prolongation of hospitalization time was found to significantly increase the risk for development of empyema (p<0.05).

Drain number:

In this study, 134 (46.5%) cases were followed-up with 1 drain and 154 (53.5%) cases with 2 drains (Table 1). In the empyema group, 90% of the cases that developed empyema had been followed-up with 2 drains. The risk for postoperative empyema development was defined as 5.8%. When these data were statistically analyzed, the use of multiple drains was found to significantly increase in the risk for empyema (p<0,05) (U: 864.000).

Thoracic lavage with povidone-iodine:

Of the case included in the study, 73 (25.3%) were administered thoracic lavage with povidone-iodine (Table 1). Of the 10 cases that developed empyema, 30% received lavage application with povidone-iodine at the end of the operation; empyema development was found in 4.1% (n:3) of the cases with lavage and 3.3% (n:7) of the cases without lavage administered. The use of lavage with povidone-iodine did not provide statistically significant protection from the development of empyema (p>0,05).

Complications:

In all periods of the study, 1 patient died, while 24 (8.3%) patients developed prolonged air leakage, 1 developed (0.3%) chylothorax, and 1 (0.3%) atelectasis. Revision operation was required in 2 (0.7%) cases due to postoperative hemorrhage and 2 (0.7%) cases due to the dehiscence in bronchial stump, while 258 (89.6%) did not develop any complications (Table 1). In the empyema group, 9 patients had empyema due to prolonged air leakage, and 1 patient had from revision operation for control of bleeding. The incidence of empyema was 37.5% in the cases with prolongation air leakage and 25% in the cases that required revision. These findings values were statistically significant in terms of the risk for empyema development (p<0.05).

Number of people in the room:

During the study period, 32 cases (11.1%) were followed-up in single rooms, 28 (9.7%) cases in double rooms, 193 (67%) cases in triple rooms and 35 (12.2%) cases in quad rooms. Empyema developed in 4 cases (12.5%) in single rooms, 1 case (3.6%) in a double room, 4 cases (2.1%) in triple rooms and 1 case in a quad room (Table 1). On examination of the types of rooms in which patients developed empyema, the cases followed up in single and triple rooms showed a significant risk for the development of empyema (p<0,05).

Sharing the same room with other cases with empyema:

Three of the cases had to share a room with 1 empyema case and 2 cases shared with other two empyema cases in the same room. Although they shared the same room with empyema cases none of those five patients developed empyema during this period. Other ten patients who developed empyema had to share same room with non-infected patients. The statistical significance difference was not calculated between these groups (p>0,05).

Emergency surgical intervention:

Of the 288 cases included in the study, 219 (76%) were operated in elective conditions, while 69 cases (24%) were operated in emergency conditions. None of the cases operated in emergency conditions developed postoperative empyema (Table 1) (p>0,05).

In multivariate analysis of the risk factors determined in our study; correlation of the risk for postoperative empyema development with primary disease, complication, basal drainage discontinuation time, apex drainage discontinuation time, and hospitalization was statistically significant (Table 4).

Table 4. Multivariate analysis of the risk factors

Dependent Variable	Mean Square	F	Sig.
Primary disease	7,030	5,353	,022
Complication	5,021	14,048	,000
Basal drainage discontinuation time	90,919	34,381	,000
Apex drainage discontinuation time	1247,881	71,624	,000
Hospitalization time	1255,103	70,130	,000

Analysis of WBC and Neutrophil values:

Leukocyte and neutrophil counts of the cases were ordered every 3 days following surgery and/or during the postoperative hospitalization period; at the end of the study period, an increase was found, as expected, in the postoperative leukocyte and neutrophil values, with significant increase in the mean leukocyte and neutrophil values at the 3rd day and mean leukocyte values at the 6th day. While preoperative mean leukocyte value in the empyema cases was 9.1, it was 14.7 at the 3rd and 13.7 at the 6th postoperative day. There was a 61.5% increase in the mean leukocyte value at the 3rd postoperative day and 50.5% at the 6th day compared to the preoperative value. The mean neutrophil value was 63.4 in the preoperative period, and increased by 27.7% to 81 at the postoperative 3rd day. The T test showed that these increases were significant ($p<0.05$; see Table 5).

Table 5. Postoperative analysis of leukocyte and neutrophil values

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Postoperative 3. day leukocyte	,008	,930	-2,745	270	,006	-3,264275	1,189338	-5,605830	-,922720
Postoperative 3. day neutrophil	4,160	,042	-2,101	270	,037	-6,27298	2,98588	-12,15154	-,39442
Postoperative 6. day leukocyte	,014	,906	-2,826	90	,006	-3,29854	1,16714	-5,61726	-,97981

Discussion

Postoperative empyema develops due to infected pleural leaves following all kinds of surgical interventions. Empyema is one of the most serious problems following tube thoracostomy. Postoperative empyemas are seen as the second most common cases among all the empyemas by 20% [4]. Symptoms and signs vary among patients developing empyema. Signs of toxicity, loss of appetite, and impairment of the general condition occur in the patients during the empyema development period. Purulent or serosanguineous expectoration and purulent drainage should be evaluated in favor of empyema. In the case of bronchopleural fistula, massive air leakage increasing with cough develops with purulent expectoration in patients with drain and subcutaneous emphysema, and increasing cough develops in the patients in whom drainage is discontinued. In general, empyema accompanies bronchopleural fistulae developing after the 8th postoperative day. Fever, cough, frothy sputum, occasionally hemoptysis, serosanguineous expectoration, pneumonia due to the aspiration to contralateral lung, and sepsis may be seen [4]. Laboratory examinations show findings compatible with infection, especially leukocytosis.

Postoperative empyema constitutes a severe problem, causing morbidity and/or mortality as well as prolonging the duration of hospital stay. Nagasaki et al. reported that mortality was 25% due to pneumonia and 22% due to empyema [1].

Many risk factors have been defined for the development of empyema following a resection, especially bronchopleural fistula and prolonged air leakage. Risk factors for postoperative empyema include advanced age, malnutrition, systemic diseases, induction chemoradiotherapy, use of steroids, obesity, right pneumonectomy, pneumonectomy complementary therapy, foreign body in pleural space, intrathoracic hematoma, prolonged operation duration, contamination of the pleural space during the operation, emergency operation after a trauma, inappropriate antibiotic therapy, postoperative pneumonia and postoperative follow-up with a ventilator [5-12]. In general, development of empyema due to these factors is seen in the early period, although it may also occur in the late period. Lung- and urinary tract infections are usually blamed for empyemas seen in the late period.

Duque et al. reported the rate of postoperative empyema development as 4.4% [13], while Belda et al. reported the rate of empyema after lung cancer surgery as 6% [14]. In our study, the rate of postoperative empyema was 3.47%, and the rate of empyema in the cases operated due to a malignancy was 8.1% (8/99).

Miller et al. reported that development of empyema ranged form 2 to 12% after pneumonectomy and from 1 to 3% after lobectomy [4]. In our study, these rates were as 7.1% (8/113) after lobectomy and 4.2% (1/24) after pneumonectomy.

Martin et al. reported the incidence of empyema as 1.3% in patients that received induction therapy [15]. In our study, no empyema was seen in the cases operated after induction therapy, but the low number of patients who received induction therapy should not be ignored.

Deschamps et al. reported that low preoperative FEV1, low lung diffusion capacity, low preoperative serum level of hemoglobin, right pneumonectomy operation, pneumonectomy complementary operation, and prolonged duration of tube drainage were associated with the risk for empyema [16]. In parallel to these results, in our study, prolonged tube drainage was found to increase the risk for empyema. However, this result has given rise to new questions: did prolongation of the drainage duration lead to empyema, or was drainage duration prolonged because of the development of empyema?

Shiono et al. reported that advanced age was a risk factor in development of empyema [17]. Although no statistical significance was found in analysis of the age factor, empyema development was more common in elderly cases.

In our study, thoracic lavage with povidone-iodine was found not to affect the development of empyema. No significant difference was found between the cases with and without lavage in terms of the risk for empyema development (4.1% to 3.3%). However, it was controversial that only 25.3% of the cases included in the study were administered lavage, the cases considered not to be at risk did not receive lavage, and number of the cases that developed empyema was small.

While 25% of the empyema group consisted of the cases that were followed-up in single and 25% in triple rooms, we regard the high incidence of empyema in the cases followed-up in single rooms as being a false-positive, because our clinical ex-

perience suggests that single rooms are generally used for the most critical cases (who are more likely to develop postoperative complications than non-critical patients). As the number of cases was small, it should not be concluded that sharing a room with the other cases with empyema does not lead to the development of empyema.

Quite different risk factors for postoperative empyema have been presented by studies conducted in several centers by many authors. In our study, in the univariate analysis; risk of empyema development was higher in cases who were operated due to malignancy, those had concomitant diabetes mellitus, patients with an operation duration longer than 210 minutes, cases developed who postoperative prolonged air leakage, those in which the number of existing drains could not be minimized, patients with prolonged basal and apex drainage, and cases hospitalized for a long time.

In the multivariate analysis; malignant primary disease, operation duration, prolonged air leakage complication, prolonged basal and apex drainage, and long hospitalization time were associated with the development of empyema.

Attention should be paid in the cases with increased leukocyte and neutrophil values, whether or not they have preoperative risk factors of empyema development.

There are limitations and differences in the results from the studies conducted so far about the risk factors for postoperative empyema. This may be due to differing approaches between clinics. Further studies to be conducted to define a more consistent series of risk factors for development of empyema. Minimization of preventable risk factors for postoperative empyema will significantly reduce rates of morbidity and mortality.

Competing interests

The authors declare that they have no competing interests.

References

References

1. Nagasaki F, Flehinger BJ, Martini N. Complications of surgery in the treatment of carcinoma of the lung. Chest 1982;82(1):25-9.
2. Pairolero PC, Deschamps C, Allen MS, Trastek VF. Postoperative empyema. Chest Surg Clin N Am 1992;2(4):813-22.
3. Lemmer JH, Botham MJ, Orringer MB. Modern management of adult thoracic empyema. J Thorac Cardiovasc Surg 1985;90(6):849-55.
4. Miller JI, Jr. Postsurgical empyemas. In: Shields TW, LoCicero J, Ponn RB, editors. General Thoracic Surgery. 5nd ed. Philadelphia: Williams and Wilkins; 2000. p. 709-16.
5. Piccione W Jr, Faber LP. Management of complications related to resection. In: Waldhausen JA, Orringer MB, editors. Complications in Cardiothoracic Surgery. St Louis: CV Mosby; 1991. p. 379-81.
6. Reed CE. Pneumonectomy for chronic infection: Fraught with danger? Ann Thorac Surg 1995;59(2):408-11.
7. Busch E, Verazin G, Antkowiak JG, Driscoll D, Takita H. Pulmonary complications in patients undergoing thoracotomy for lung carcinoma. Chest 1994;105(3):760-6.
8. Barrera R, Shi W, Amar D, Thaler HT, Gabovich N, Bains MS, et al. Smoking and timing of cessation: Impact on pulmonary complications after thoracotomy. Chest 2005;127(6):1977-83.
9. Smetana GW. Preoperative pulmonary evaluation. N Engl J Med 1999;340(12):937- 44.
10. Smith MA, Patterson GA. The complications of surgery for lung cancer. In: Pass HI, Carbone DP, Johnson DH, Minna JD, Turrisi III AT, editors. Lung cancer: principles and practice. 3rd ed. Philadelphia: Lippincott; 2005. p. 491-505.
11. Iwamoto K, Ichiyama S, Shimokata K, Nakashima N. Postoperative pneumonia in elderly patients: incidence and mortality in comparison with younger patients. Intern Med 1993;32(4):274-7.
12. Hansen LA, Prakash UB, Colby TV. Pulmonary complications in diabetes mellitus. Mayo Clin Proc 1989;64(7):791-9.
13. Duque JL, Ramos G, Castrodeza J, Cerezal J, Castanedo M, Yuste MG, et al. Early complications in surgical treatment of lung cancer: a prospective, multicenter study. Ann Thorac Surg 1997;63(4):944-50.
14. Belda J, Cavalcanti M, Ferrer M, Serra M, Puig de la Bellacasa J, Canalis E, et al. Bronchial colonization and postoperative respiratory infections in patients undergoing lung cancer surgery. Chest 2005;128(3):1571-9.
15. Martin J, Ginsberg RJ, Abolhoda A, Bains MS, Downey RJ, Korst RJ, et al. Morbidity and mortality after neoadjuvant therapy for lung cancer: the risks of right pneumonectomy. Ann Thorac Surg 2001;72(4):1149-54.
16. Deschamps C, Bernard A, Nichols FC 3rd, Allen MS, Miller DL, Trastek VF, et al. Empyema and bronchopleural fistula after pneumonectomy: factors affecting incidence. Ann Thorac Surg 2001;72(1):243-7.
17. Shiono S, Yoshida J, Nishimura M, Hagiwara M, Hishida T, Nitadori J, et al. Risk factors of postoperative respiratory infections in lung cancer surgery. J Thorac Oncol 2007;2(1):34-8.